Energy efficiency – Political targets and reality. Case study on EE in the residential sector in the German Climate Change Programme

Oliver S. Wagner
Wuppertal Institute for Climate Energy Environment
Döppersberg 19,
D-42103 Wuppertal
oliver.wagner@wupperinst.org

Stefan Lechtenböhmer
Wuppertal Institute for Climate Energy Environment
stefan.lechtenboehmer@wupperinst.org

Stefan Thomas
Wuppertal Institute for Climate Energy Environment
stefan.thomas@wupperinst.org

Keywords

Energy efficiency, policies and measures, evaluation, monitoring, residential sector, legal instruments, fiscal instruments, incentives

Abstract

The German climate change programme (2000) identified the residential sector as one of the main sectors in which to achieve additional GHG reductions. Our case study compiles results of existing evaluations of the key policies and measures that were planned and introduced and carries out some own estimates of achievements. We show, which emission reductions and which instruments where planned and what was delivered until 2004.

Legal instruments such as the revised building code were introduced later than planned and their effects will – at least partly – fall behind expectations. Other legal instruments such as minimum energy performance standards for domestic appliances etc. were – in spite of the programme – not implemented yet.

On the other hand, substantial financial incentives were introduced. Especially schemes granting low-interest loans for building renovation were introduced. However tax subsidies for low-energy buildings were phased out.

In general we can conclude from our case study that Germany was not able to compensate for the slower or restricted implementation of legal instruments through the introduction of financial incentives. Particularly the efficient use of electricity has been left aside as almost no further policy action was taken since 2001.

Thus energy efficiency in the residential sector will not deliver the GHG reductions planned for in the German climate change programme until 2005. From our findings we draw conclusions and recommendations towards policy makers: Which lessons are to be learnt and what has to be done in order to fully harness EE potentials in residential sector as planned for 2010?

Introduction

With the entry into force of the Kyoto Protocol on the 16th of February a new political regime has been established. Parties to the protocol have to reach binding greenhouse gas reduction targets until the 1st compliance period from 2008 to 2012. They have to report on the steps they have taken and what measures they have put in place or are going to implement. What is really new is that it is no longer sufficient for the states to implement certain policies; they now have to implement them in a way enabling achievement of their targets. This puts much more emphasis on the evaluation and monitoring of the success of implemented actions than was practiced before in many states. The first milestone have to be reached by the end of 2005 when the states have to prove demonstrable progress towards their targets.

In this paper we will take German energy efficiency policy as an example for examining the difference between targets, which were possibly not well enough quantified or backed by concrete policies, and reality, and for drawing some general and some concrete conclusions in order to improve political planning and implementation of EE policy.

In the National Climate Protection Programme (NCPP) of 2000, Germany concluded from the most recent energy projection (Prognos / EWI 1999) and the policies and measures implemented between 1998 and 2000 that under busi-

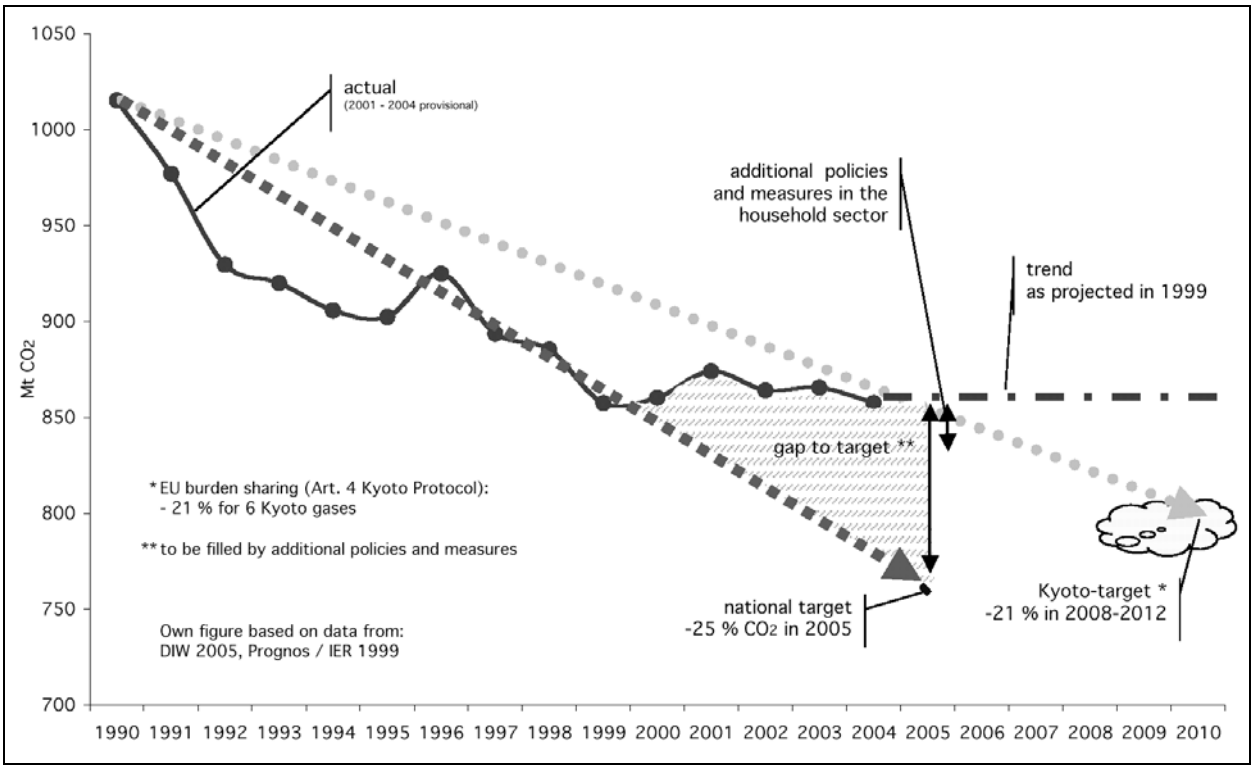

Figure 1. *Actual and projected CO_2-emissions of Germany and emission reduction targets.*

Table 1. Policies and measures in the household sector as proposed by the German National Climate Protection Programme.

No.	Measure	Emission reduction in Mt of CO_2
4	Energy savings ordinance (building code and certification)	4
6	Subsidy program for energy savings in existing buildings, including the implementation of energy audits	5 - 7
10	EU minimum energy performancve standards for appliances and standby; Measures directed at the electricity consumption (particularly standby mode) of electrical and electronic appliances in households and offices; voluntary commitments and tighter/extended legislation on energy labelling	5
16	Promoting the use of natural gas	3,1
	Total for households	**17 - 19**

Source: extracted from BMU 2000

ness as usual conditions the national target of a reduction of CO_2-emissions by 25% until 2005 would be missed by about 5 to 7% or about 50 to 70 Mt of CO_2 (see Figure 1). Consequently, a set of additional policies and measures were identified in order to fill the gap to the target, among which private households and buildings should be responsible for additional emission reductions of 18 to 25 Mt (BMU 2000) of which 17 to 19 Mt were allocated to four concrete groups of measures concerning energy savings in buildings and savings of electricity (see Table 1).

In the following we will examine how these policies were implemented and which CO_2 reductions they delivered.

Evaluation of measures targeted at energy savings in residential buildings

ENERGY SAVINGS ORDINANCE

The Energy savings ordinance was the long planned successor of the former ordinances for thermal insulation (last updated in 1994) and that on heating systems (last updated in 1998). The NCPP had the target of passing the ordinance by fall 2000 (IMA 2000, 43). Mainly by the means of 30% tighter standards for new houses and mandatory exchange of boilers installed prior to 1978 it was expected to save about 4 Mt of CO_2 by 2005.

However, due to the fact that the ordinance needed the acceptance by the second chamber (the Bundesrat), it was delayed and partly watered down in the course of the legislative process . It finally entered into force on the 1st of February 2002. All buildings approved after that date were due to comply to the new regulation.

Regarding the effectiveness of the regulation on the energy consumption of new buildings no empirical evaluation has been carried out so far. What makes the evaluation difficult is the fact that implementation and control of the ordinance is the responsibility of the states, leaving some flexibility to them. However, most existing studies assume that new buildings – mainly due to the changes made in the bargaining process on the regulation – consume only about 25% less than they would have under the previous legislation (see Prognos/IER 2004,115; DIW et al. 2004).

Prognos and IER (2004) estimate that the energy savings ordinance has reduced emissions of new houses – including some effects of the renovation of existing houses – by about 0.4 Mt of CO_2 in 2002 and 2003. The annual emission reduction would thus be at about 0.2 to 0.3 Mt.

Regarding the mandatory exchange of boilers DIW et al. (2004) estimate that the ordinance will have hardly any effects. On the one hand they assume a relatively high autonomous turnover of boilers of 4% per year and on the other hand they expect quite a low compliance for this regulation – in spite of the fact that annual controls by chimney sweepers have been a legal requirement in Germany for decades – and lower de-facto reductions by these measures than expected in theory.

Until 2010 DIW et al. (2004) expect emission reductions of about 3.2 Mt of CO_2 for the energy savings ordinance together with a couple of supportive measures and including some effects in the renovation. An extrapolation by Prognos/IER (2004) arrives at even slightly lower effects of 2.3 Mt.

For 2005 it can thus be concluded that the expected emission reductions could not be achieved by the energy savings ordinance. Instead of the expected reductions of 4 Mt of CO_2 only about 0.7 to 1.4 million have been achieved if the most recent studies on the topic are correct.

Reasons for the underdelivery of this measure were:

- The – probably foreseeable – delay in the process of bringing the regulation into force and the partly watering down of its provisions during the negotiations between federal government and the states;
- Possibly overoptimistic assumptions with regards to the effectiveness of the regulation towards the exchange of old boilers and also possibly with regards to the amount of new buildings constructed in the respective period until 2005[1].

SUBSIDY PROGRAM FOR ENERGY SAVINGS IN EXISTING BUILDINGS, INCLUDING THE IMPLEMENTATION OF ENERGY AUDITS

The NCPP identified the renovation of existing buildings as a priority task. By the means of the "climate protection programme for existing buildings" – which provides grants at reduced interest rates – investments of 1 billion Euro per year were envisaged. For this purpose, 200 million Euro per year of subsidies to reduce interest were earmarked by the government. In addition, the federal investment bank (KfW) was asked to prolong the existing CO_2 reduction programme by at least five years. Together both programmes were estimated to deliver CO_2 reductions of 5 to 7 Mt per year in 2005.

Both measures were implemented as planned. The "climate protection programme for existing buildings" started operation in January 2001 offering loans at 3% points below market interest rates for initially four different combination packages of emission reduction measures with a minimum CO_2-reduction of 40 kg per m^2 and year. Eligible for the loan are 100% of the costs up to 250Euro per m^2. Later the programme was expanded to a fifth package allowing for the exchange of heating systems alone and a support for low energy renovations with improved conditions.

Between 2001 and mid 2004, almost 60 000 loans with a volume of about 3.2 billion Euro were granted, allowing for the renovation of 166 600 dwellings in existing buildings (BMVBW 2004). Additionally loans of almost 170 million Euro were provided for the improvement of 2 700 houses to low energy homes. The existing CO_2-reduction programme was prolonged as well and supplied about 850 million Euro in 2003 alone. These numbers show that the government took its target serious. The annual target of 1 billion Euro invested was reached – if not exceeded[2].

However, reductions of CO_2 fall short of expectations. DIW et al. (2004, 104) now estimate the total effects of both programmes until 2010 at about 6 Mt of CO_2[3]. Prognos IER (2004) are even slightly more pessimistic. If these new estimates are correct, we can conclude that the subsidies toward energy improvements of existing buildings will not provide for more than 2 to 2.5 Mt of CO_2–reduction by 2005, which is less than half of the reduction that was expected in the NCPP.

A first analysis of the available overall data indicates some reasons why the programmes did not deliver the emission reductions that were expected before. A calculation that we performed in 2001 showed that the targeted emission reductions were only achievable assuming that the projects supported would apply, on average, for loans of about 80 Euro per m^2 (versus a maximum of 250 Euro per m^2 eligible cost) and would deliver CO_2 emission reductions of between 75 and 105 kg per m^2 and year compared to a minimum of 40 kg per m^2 and year[4]. We thus added a sensitivity analysis assuming a worst case scenario, in which the maximum loan per m^2 and the minimum CO_2 reduction were combined, which showed a minimum effect of the programme of 0.8 Mt of CO_2 until 2005 (Lechtenböhmer et al. 2001).

From the published overall results of the programme it can be easily calculated that – assuming the average size of 90 m^2 per dwelling – the loans granted had a level of more than 200 Euro per m^2 which is close to the pessimistic sensitivity analysis. On the other hand – if the estimates are reliable – the emission reductions achieved could be around

1. As the NCPP does not specify how the anticipated effects were calculated, an exact evaluation of these apparent overestimates is not possible in this paper.
2. Not every investment might have been financed at a 100% ratio. The KfW estimates the jobs created or secured by the programme at about 20 000 annually leading to reduced expenditure and higher income for the public budget to an extent higher than the subsidies paid.
3. It has to be mentioned that both programmes were merged with a third programme and restructured. The new structure is effecive from the 1st of January 2005.
4. For the calculation, an average size of dwelling of 90 m^2 was assumed.

95 to 120 kg per m^2 and year, which is slightly more than we expected in 2001.

For this measure it shows out that the government took its target serious and was more or less able to reach the planned amount subsidized loans into the market. However, the expected emission reductions showed out to have been estimated overoptimistic – which was relatively clear even at the time the targets were set up as our analyses from 2001 show.

PROMOTING THE USE OF NATURAL GAS

The third reduction measure for the household sector quantified in the NCPP was the promotion of the use of natural gas. For this – characterized as ongoing – measure a potential of 3.1 Mt of CO_2 reduction was expected until 2005. As the NCPP lacks a more detailed description of this measure[5] it is unclear what concrete measures were planned with this respect. In Lechtenböhmer et al. (2001) it was assumed that this measure should reflect the efforts of the natural gas industry in order to promote the use of natural gas in the household sector.

In fact, between 2000 and 2003 the share of natural gas in the final energy demand of the household sector increased from 36 to 39%. This shift alone led to a reduction of CO_2 emissions by more than 1.6 million tonnes, assumed that otherwise light fuel oil would have been used. If recent expansion of natural gas would be simply extrapolated up to 2005 and also taken into account the somewhat higher efficiency of gas fired appliances a CO_2-reduction of almost 3.1 Mt – by fuel switch to natural gas in the household sector – might be achieved.

This measure is thus the only one aimed towards the building sector, which more or less seems to have fulfilled its expectations. However, as its definition as ongoing measure already indicates, this measure can hardly be interpreted as additional or really new. On the one hand it is obvious that the natural gas industry has actively promoted its product since decades. This is one reason why natural gas gained its position as number one fuel used in the household sector in Germany. In new developments, natural gas today has a market share of more than 70%. On the other hand, the energy projections which were used as the baseline for the assumption of an additional need of 50 to 70 Mt of CO_2-reduction (mainly Prognos/EWI 1999) already had assumed a significant shift toward natural gas in the residential space heating market.

Evaluation of measures targeted at electricity savings in household sector

Germany's 2001 NCPP proposed two types of policy instruments for improving the energy efficiency of electric appliances: (1) EU minimum energy performance standards for appliances and standby; and (2) (presumably national) measures directed at the electricity consumption (particularly standby mode) of electrical and electronic appliances in households and offices; voluntary commitments and tighter/extended legislation on energy labelling. The expectation was that these together would reduce CO_2 emissions by 5 million tonnes per year by 2005 already.

Which of these measures have been implemented?

- There is a new EU Directive creating a minimum energy performance standard for ballasts for fluorescent lamps. The effect of this has not been quantified.
- The European Commission has achieved negotiated agreements or voluntary self-commitments with manufacturers and importers of clothes washers, dish-washers, television sets, video recorders, external power supplies, and audio sets. The effect of these has not yet been quantified either.
- New EU energy labels have been created for household lamps, electric ovens, and room air conditioners. The label for cold appliances was amended by adding two subclasses A+ and A++. Market introduction of the new classes was accelerated by the European Energy+ project on co-operative procurement. We do not know of any quantification of the CO_2 reductions due to these new policies.
- Consumer agencies, energy companies, and others inform consumers about energy-efficient appliances. Nobody has evaluated their effect.

Furthermore, from 2003 to 2004 there was a nation-wide information and motivation campaign on energy efficient white goods, CFLs, and on the reduction of standby energy consumption by the "Initiative Energieeffizienz", co-ordinated by the German Energy Agency dena, and jointly funded by the associations of energy companies and the German Federal Foundation for the Environment (DBU). It was estimated beforehand to reduce CO_2 emissions by 2 million tonnes per year. DIW et al. (2004) simply add these to the 5 million tonnes per year attributed to the above-mentioned measures by the NCPP. However, no quantitative bottom-up evaluation of the actual savings from the campaign of the "Initiative Energieeffizienz" has been published yet either.

The only measure of the instruments listed above that was quantified by DIW et al. (2004) is the labelling. Based on a study by ISI and GfK (2001) they calculate CO_2 reductions for Germany compared to the baseline from the EU energy label for white goods of 150 000 tonnes by 2000. If that effect has continued since, it would amount to around 300 000 tonnes by 2005. On the other hand, ISI and GfK (2001) made a scenario calculation leading to the expectation that labelling of white goods would lead to reductions of around 1.5 million tonnes of CO_2 by 2005, and up to 3.8 million tonnes by 2010.

There can, therefore, be doubts about whether electric energy efficiency has brought CO_2 reductions anywhere near the 5 or 7 Mt targeted. This does not mean the potential is not there – rather that the appropriate policies to make it a reality were not (yet) in place. Two reasons for this failure to achieve the target can be observed.

5. The background paper of the respective IMA working group 3 for the building sector does not even mention this measure (IMA/AK 3 2000).

Table 2. Revised calculation of targets that can be achieved by the measures for the household sector included in the German National Climate Protection Programme.

No.	Measure	Emission reduction in Mt of CO_2		
		As planned in NCPP for 2005	Now expected for 2005	Now expected for 2010
4	Energy savings ordinance (building codes and certification)	4	0.7 – 1.4	2.3 – 3.2
6	Subsidy program for energy savings in existing buildings, including the implementation of energy audits	5 – 7	2 – 2.5	6 (if prolonged)
10	EU minimum energy performancve standards for appliances and standby; Measures directed at the electricity consumption (particularly standby mode) of electrical and electronic appliances in households and offices; voluntary commitments and tighter/extended legislation on energy labelling *Possible with stringent energy efficiency programmes and EU legislation*	5	Not available; maybe 2 to 3?	Not available *4.2 (in addition to 2005)*
16	Promoting the use of natural gas	3.1	(3.1 but not additional)	–
	Total for households	**17 – 19**	**(~4.7 – ~6.9)**	

Source: own calculations based on BMU 2000, DIW et al. 2004, Prognos/IER 2004, Lechtenböhmer et al 2001

- First, the NCPP relied on policies that were not in the hands of the German government alone but needed EU legislation, such as EU minimum energy performance standards and labelling for appliances. These were delayed; e.g., the Directive on ecodesign of energy-using products was first proposed in 2002 and is still not adopted. There is not even a proposal for the labelling framework Directive foreseen in the work programme for the first phase of the European Climate Chance Programme on the table yet. Both framework Directives would make adoption of standards or labels for individual tapes of appliances or equipment much easier, since this would no longer require the lengthy adoption procedure of co-decision by the European Parliament and Council. But as the framework Directives have not been adopted, the practical implementation of new or revised labels and standards has been slow these last years (cf. examples quoted above).
- Second, measures that can be taken at national level are information campaigns, targeted advice, and rebate programmes to accelerate market uptake of the most energy-efficient appliances. Out of these, only a two-year information campaign has been implemented in Germany. Even if it reached its 2 million tonnes target, which is far from sure, it would not be sufficient to achieve the overall 5 or 7 million tonnes target.

Experiences from EU Member States show: energy efficiency programmes and services alone can reduce energy consumption by around 1% per year compared to the baseline (Wuppertal Institute et al. 2002; Irrek et al. 2003; Thomas et al. 2003). For Germany, this could achieve CO_2 reductions of around 15 million tonnes from reduced electricity consumption in all sectors between 2005 and 2010. However, the household sector would only contribute with 4.2 million tonnes.

Conclusions

As can be seen in Table 2 the additional demand side energy efficiency measures in the residential sector that were adopted in Germany's National Climate Protection Programme (NCPP; BMU 2000) seem to have delivered only a part of the additional emission reductions that were planned for the year 2005. However, reliable evaluations are still missing. Based on recent studies and estimates we can conclude that the four measures that were assigned with concrete targets of together 17 to 19 Mt CO_2 reduction will only deliver roughly about a third – we guess that additional emission reductions by theses measures will reach only about 4.7 to 6.9 Mt.

This analysis shows how valuable and important the establishment of detailed and quantified targets under the UNFCCC and its Kyoto Protocol is. The quantified programmes that were developed are now available for evaluation by the governments themselves and by third parties – as done in this paper. The results of these evaluations can be used to improve the climate policy in order to better achieve the targets as well as an improvement of the methodology in order to improve the quality of future policy planning. The higher transparency may also exert pressure on policy makers in order to properly plan and implement what they promise.

With this respect our paper has two main fields to conclude on:

- First, we can produce some methodological results, e.g. answers to the question "Why were the assumptions not achieved?"
- Second, we can conclude on the policy priorities that the German government adopted: "How should climate policy be improved?"

WHY WERE THE ASSUMPTIONS NOT ACHIEVED?

The reasons that we found for this small part of the German NCPP of 2000 alone are manifold. On the one hand, the ex-ante evaluation of deliveries to be expected from the policies typically overestimated the outcomes by far (see Table 2). Reasons for this were delays in implementation of the policy, watering down of proposed policies during the implementation process, and inclusion of policies that were beyond the national scope. Furthermore, some of the expectations were simply overoptimistic. This list shows that a number of pitfalls do exist for overestimating the results of planned policies. However, in a couple of cases this was no real surprise – the risks were known before and overoptimism was partly quite obvious. This also leads to the question whether policy makers could be subduced to overestimate outcomes when they are under pressure to deliver an overall target.

But German government seems to have learned from this process. The GHG reductions now expected (in the studies – the NCPP 2 is still not published) – probably due to first practical experience with the policy now implemented – seem to be much more realistic than the initial ones. It should be noted, however, that still no real bottom-up evaluation of the deliveries of the policies mentioned here has been carried out.

HOW SHOULD GERMAN CLIMATE POLICY IN THE RESIDENTIAL SECTOR BE IMPROVED?

Although quite an effort was made to reduce the demand for heating energy, demand-side energy efficiency in the household sector has not delivered the expected contribution to GHG mitigation. Does this mean that the potential is not there as it was expected? It is our conclusion that the potential is still there – but not (yet) the appropriate policies to make it a reality. Much more stringent energy efficiency programmes, combining individual targeted advice, direct financial incentives rather than (or in addition to) soft loans, co-operation with manufacturers, retailers, and installers, and much more publicity for energy efficiency are needed particularly for stimulating energy efficiency in existing buildings. What is most important, these programme elements should be provided by one agent or at least linked together by local networks and co-ordination centres. So far, e.g., the energy audit and the soft loan programmes in Germany have been provided by different programmes and different agents.

Another paper at this Summer Study (1,224 by Thomas and Irrek) shows that such programmes financed and co-ordinated by an Energy Efficiency Fund could save electricity and other energy equivalent to about 30 million tonnes of CO_2 compared to the baseline. Most of this will already be achieved by 2010.

Of course, further energy labels, minimum energy performance standards and building regulation will also contribute to implementing the potential, using synergies with energy efficiency programmes and services. The German government, as well as the governments of all other Member States, is therefore well-advised to act in favour of a rapid and stringent adoption and implementation of the EU Directives on energy end-use efficiency and energy services, ecodesign of energy-using products, and a framework Directive on energy labelling.

References

BMU, Federal Ministry for Environment and Reactor Safety (2000): Germany's National Climate Protection Programme, Summary, October 2000, Berlin

BMVBW Federal Ministry of Transport, Building and Housing (2004): "Bericht zur Gebäudeenergieeffizienz", September 2004, Berlin

DIW et al. 2004, [Deutsches Institut für Wirtschaftsforschung] / ISI [FhG-Institut für Systemtechnik und Innovationsforschung] / Öko-Institut / STE [Forschungszentrum Jülich – Programmgruppe Systemforschung und Technologische Entwicklung] (2004): Politikszenarien für den Klimaschutz – Langfristszenarien und Handlungsempfehlungen ab 2012 (Politikszenarien III), ufoplan 20141142

IMA/AK 3 (2000): Fünfter Bericht des Arbeitskreises III „Gebäudebereich" der Interministeriellen Arbeitsgruppe „CO_2CO2-Reduktion" in IMA 2000, Berlin

Irrek, Wolfgang et al. (2003): European Best Practices in DSM Programmes and in Supportive Policies Aimed at the Full Exploitation of the Economic, Social and Environmental Benefits of Energy Efficiency on the Demand Side. In: eceee (ed.), Time to turn down energy demand, eceee 2003 Summer Study, Proceedings, Paper 1,227, Stockholm

ISI (Fraunhofer Institut für Systemtechnik und Innovationsforschung) and GfK (GfK Marketing Services GmbH & Co. KG) (2001): Evaluierung zur Umsetzung der Energieverbrauchskennzeichnungsverordnung (EnVKV). Karsruhe, Nürnberg, März 2001.

Lechtenböhmer et al. (2001): Beitrag zum Klimaschutzkonzept Nordrhein-Westfalen für die Bereiche Querschnittsmaßnahmen, Haushalte, Erneuerbare Energien, Abfall- und Landwirtschaft. Im Auftrag des Ministeriums für Wirtschaft und Mittelstand Energie und Verkehr des Landes Nordrhein-Westfalen, Wuppertal Institut, Wuppertal

Prognos / EWI (1999): Die längerfristige Entwicklung der Energiemärkte im Zeichen von Wettbewerb und Umwelt, für das Bundesministerium für Wirtschaft und Technologie, Basel

Prognos / IER (2004): Analyse der Wirksamkeit von CO_2-Minderungsmaßnahmen im Energiebereich und ihre Weiterentwicklung; im Auftrag des Bundesministeriums für Wirtschaft und Arbeit

Thomas, Stefan et al., 2003, Bringing Energy Efficiency to the Liberalised Markets. In: eceee (ed.), Time to turn down energy demand, eceee 2003 Summer Study, Proceedings, Paper 1,135, Stockholm

Thomas, Stefan; Irrek, Wolfgang, 2005, Will there be an Energy Efficiency Fund in Germany? Paper 1,224 in these proceedings.

Wuppertal Institute et al., 2002, Bringing Energy Efficiency to the Liberalised Electricity and Gas Markets, How Energy Companies and Others can Assist End-Users in Improving Energy Efficiency, and how Policy can Reward such Action. Wuppertal.